New Product

The 3300/53 Overspeed

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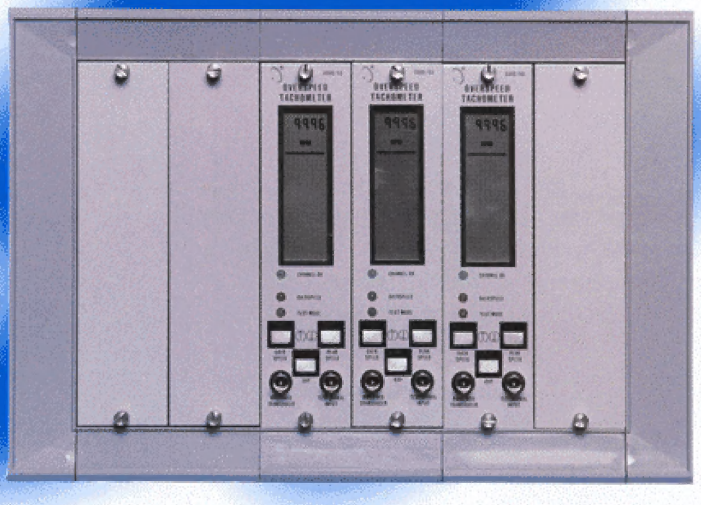
American Petroleum Institute Specification 612 is being revised to require electronic, rather than mechanical, overspeed protection on special-purpose steam turbines. Previous issues of API 612 — Special Purpose Steam Turbines for Petroleum, Chemical and Gas Industry Services, specified a mechanical overspeed system for these turbines. API 612 now specifies an electronic system, with a mechanical system optional. It also requires separate systems for overspeed shutdown and for governor control.

Bently Nevada's new 3300/53 Overspeed Protection System is a fast-response 3300 System Tachometer with redundant channels that is suitable for use in many overspeed shutdown systems. The system can stand alone, or be integrated into a Bently Nevada 3300 Vibration Monitoring System and supply data to a Distributed Control System.



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Consequences of overspeed

Turbine overspeed is a very hazardous condition because a turbine usually sustains significant damage or destruction if it is allowed to run beyond its rated maximum speed. In a steam turbine, the consequences are often more serious than in a gas turbine. At very high speeds, a steam turbine will burst, releasing high pressure steam. This usually causes extensive secondary damage that can take months to repair. Consequently, most steam turbines have an overspeed shutdown system as part of their emergency shutdown system.

Although a gas turbine in an overspeed condition usually does not release high-pressure steam, it can still incur extensive damage. For this reason, gas turbines, too, are usually fitted with overspeed shutdown systems.

Mechanical overspeed systems

In the petrochemical industry, steam turbines drive a variety of machines. Those that drive critical machines are termed special-purpose steam turbines. They usually have a trip valve and a governor valve in each steam inlet line that require continuous hydraulic pressure to remain open. This hydraulic pressure comes from a manifold that has various devices connected to it to release that pressure when it is necessary to stop the machine.

A mechanical overspeed shutdown system is triggered by a spring-loaded bolt installed in the turbine rotor. When the rotor's speed becomes great enough, centrifugal force overcomes the spring force and the bolt extends from the rotor. Upon extension, it strikes a hydraulic valve that releases the hydraulic pressure from the manifold and closes the trip and governor valves. In a properly designed and maintained system, this shuts off the flow of steam to the turbine and the turbine coasts to a stop.

Government regulations and industry trends

OSHA (The Occupational Safety and Health Administration in the USA) Standard 1910.119 Recommendations for

Protection System

Process Hazards Management of Substances with Catastrophic Potential has led to these industry trends:

- Protective systems that are separate from control systems
- Fault tolerant protective systems
- Periodic verification of safety protective systems and test record maintenance

Mechanical overspeed shutdown systems have shortcomings in view of these trends. Testing, required for periodic verification, is difficult and time-consuming. Usually, the tested machine must be taken off-line, disconnected from its load and run at overspeed to verify that the spring-loaded bolt extends and the turbine shuts down. This often takes days and has a significant impact on production. Also, fault tolerance through redundant mechanical systems is difficult to achieve, because most special-purpose steam turbines have only enough room to install one spring-loaded bolt.

Advantages of electronic overspeed shutdown systems

An electronic overspeed shutdown system is easier to test than most mechanical systems. A properly configured electronic overspeed shutdown system can be tested with the machine online. A signal generator input can verify the system's accuracy and simulate machine overspeed.

An electronic overspeed shutdown system can be designed with greater fault tolerance than a mechanical system. A three-channel electronic overspeed shutdown system can be designed so that no single-point failure will cause a false or missed trip.

Additionally, control and protection systems can be simplified by combining as many functions as possible into each separate unit. The trends that are a result of governmental regulations (for example OSHA 1990.110 in the USA) dictate separate protection and control functions. However, overspeed protection and vibration monitoring can be combined while still maintaining their separate functions. If the combined system has a Serial Data Interface, overspeed protection and vibration data can share the same input to a Distributed Control System.

The 3300/53 Overspeed Protection System

The 3300/53 Overspeed Protection System uses multiple, redundant electronic tachometers. When the 3300/53 senses overspeed, its relays de-energize, causing the solenoid valves to open. When the solenoid valves open, they release pressure from the manifold. That causes the trip and governor valves to close. Deprived of steam, the turbine coasts safely to a stop.

The 3300/53 is easy to test, by applying a test signal through a front panel connector.

Stand alone capability

The 3300/53 can stand alone or it can be integrated into a 3300 Rack with vibration, temperature and other monitors. It stands alone if mounted in a 3300 Rack without the 3300 System Power Supply and System Monitor. Each 3300/53 channel has its own power supply, so an additional power supply is not required.

If the 3300/53 is integrated into a 3300 Monitoring System with a Serial Data Interface, vibration and Overspeed Protection System data is available to a Distributed Control Systems through a single interface. The data available are:

- Current machine speed
- Highest machine speed since last reset
- Alarm setpoint
- Alarm status
- OK status

The 3300/53's alarm can be used to trigger a Bently Nevada Transient Data Manager®/Dynamic Data Manager® System to initiate dynamic data capture. Vibration and process data are captured automatically when the alarm occurs and saved for later reduction and analysis.

Three- and two-channel systems available

The 3300/53 is available in both three- and two-channel configurations. In either a two- or three-channel configuration, the 3300/53 is fault tolerant, and can provide an alarm on power loss to all channels. The three-channel configuration is preferable because it allows an overspeed shutdown system to be designed with a higher degree of fault tolerance than can be achieved with a two-channel system. Where a three-channel system is not feasible, a two-channel system can be used.

The 3300/53 was designed specifically for use in a primary overspeed shutdown system on special-purpose steam turbines. However, its features make it desirable in other applications, such as primary and secondary overspeed shutdown systems for gas turbines and other steam turbines.

Bently Nevada's 3300/53 Overspeed Protection System is the solution to the requirements of API 612 and other specifications as part of a reliable, fault-tolerant overspeed shutdown system. For more information, contact your nearest Bently Nevada Corporation sales or service representative. ■